

Application No. 10,820,522
Amendment dated 17 Mar 2006
Reply to Office Action of November 17, 2005

Remarks:

Claim rejections-35 USC §102

Claims 1-6 stand rejected under 35 USC §102(b) as being anticipated by U.S. Patent 5,659,478 (Pennisi et al). This rejection is respectfully traversed.

Claims 1-6 have been amended to distinguish over the reference cited by the Examiner. In particular, Claim 1 has been amended to add the limitation of "said workpiece comprising a plurality of surfaces meeting to form complex edges" which, within the context of the present invention, is intended to identify workpieces such as complex spiral gears, turbine blades, cast housings and the like which have complex shapes such as gear teeth, curved blade vanes and intersecting curved and planar surfaces which, after manufacturing, require further finishing to meet specified tolerances.

The present invention involves methods for manufacturing a work piece and then, in a separate set of operations, finishing that piece to remove imperfections such as burrs and the like. A second embodiment of the present invention involves taking an existing work piece and performing finishing operations upon it.

Applicant is unaware of any computer-controlled machining system that will perform highly-toleranced finishing operations on an existing work piece by modifying the machine instructions used to manufacture the work piece to operate a robotically controlled finishing tool. In fact, the prior art cited by applicant to the Patent Office confirms this observation.

U.S. Patent 5,091,861 (Geller et al) teaches and describes a system for automatic finishing of machine parts which uses a computer-generated solid model of the work piece and claims to use this data to successfully operate a computer-controlled deburring machine. The applicant states, "Automatic, computerized systems for deburring are not known to the inventors." A careful reading of the Geller reference demonstrates that the only deburring operation identified is that of deburring a straight edge on a part for which a specifically designed clamp must be used. There is no description in Geller et al of deburring or otherwise machining complex curved edges or surfaces on work pieces. See, for example, Figs. 4a, 4b and 4c illustrating the part and the only surface to be deburred (80 in Fig. 4a) the tower of individual clamps (Fig. 4b) and a cross-section of an individual clamp showing how the part is held during deburring process.

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U.S. Patent 6,079,090 (Ungaro) teaches and describes a numeric controlled machine tool for turning and hobbing mechanical parts. Although this reference states at col. 4, line 26: "Moreover, the carriages 4 and 6 can machine simultaneously by using the hobbing tool together with another tool of the carriage 4, for example to deburr by skimming the part at the region where the hobbing tool reduces its pressure. The machine tool is also capable of chamfering the gear during gear hobbing."

Nowhere in this reference does the inventor describe how this process is carried out or how the chamfering or deburring tools are controlled.

U.S. Patent 5,785,771 (Mitchell Jr. et al) teaches and describes a method for manufacturing precision gears described in detail the benefits of precise manufacture of such gears and the benefits of chamfering such gears to reduce stress. Mitchell Jr. describe a masking process used to allow selective portions of the manufactured gear to be hardened. In Fig. 1c, the inventors illustrate the chamfering of a gear surface but do not describe any automated method for doing this.

U.S. Patents 6,074,481 (Bittner et al) and 6,080,349 (Bittner et al) also teach and describe masking tools used to allow the selective hardening of the gear surface.

U.S. Patent 5,810,522 (Parker) entitled "Hand Held Bar Edging Tool and Support Therefor," U.S. Patent 4,334,810 (Behrke et al) entitled "Gear Deburring Apparatus and Method," and U.S. Patent 4,412,765 (Occhialini) entitled "Apparatus for Facilitating Chamfering/Deburring Tool and Gear Meshing" are all representative of apparatus used to position a gear so that the hand operation of deburring, chamfering or other machining actions can be taken.

U.S. Patent 5,154,533 (Baumstark) teaches and describes an apparatus for chamfering and deburring the end edges of a tool production gear which is also hand process rather than a computer controlled process.

Use of computer-controlled machine tools to deburr complex gears is described in an article submitted to the Patent Office by the applicant entitled, "Robotic Automated Deburring of Aerospace Gears" which appeared in the January/February 2001 issue of *Gear Technology Magazine*, and was written by Michael Nanlawala. In this article, the author describes with great particularity the importance of having precisely chamfered and deburred gears when used in aerospace and aeronautical applications and also describes efforts made by others to automate this process by using computer-controlled machine tools. To applicant's knowledge, none of these processes have been a commercial success.

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The process as described in the article used the "teach pendant" method of identifying to the computer a path along which a finishing tool must travel. This is a tedious, time consuming and somewhat inaccurate process whereby the machine tool must be manually positioned on a portion of the contour to be machined, and the point recorded in the computer's memory. Where a work piece has a number of curved surfaces, or has gear teeth with opposed edges that must be finished, a great number of these points must be identified. It is also not certain that a series of points identified on one work piece will work for other work pieces even though all were made by the same machine-controlled process.

The desirability to use the computer to "model" the gear surfaces and use this modeling to control the finishing tool is described in an article entitled "New Gear Software" appearing in the January/February 2000 issue of *Gear Technology Magazine*. This reference has also been submitted to the office for consideration. The author describing the process states that he does not recommend using his product for creating the geometry needed to manufacture a spiral bevel gear by traditional metal cutting methods.

If the software cannot be used to cut the gear in the first place, it certainly cannot be used to later identify the surfaces on the gear with particularity to either deburr, chamfer or otherwise machine or finish them.

The foregoing review of the art clearly demonstrates that the invention described by applicant is neither taught nor suggested by these references taken together or individually. No reference teaches or suggests applicant's approach to solving the problem of using the computer-controlled robotic machining arm to successfully track and finish anything other than a linear surface without requiring the use of specially designed jig holders or other expedients.

For the foregoing reasons, the claims as amended should be allowed, and the application should be passed to issuance.

Applicant respectfully contends that the application, with claims 1-6 as amended, and with claim 19 cancelled, is now in condition for allowance. Should the Examiner have any further questions, please telephone the undersigned directly.

Respectfully submitted,

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